2. DESIGN CRITERIA

2.1 Group 5 Data Quality Objectives

To help with defensible decision making, the EPA has developed the data quality objective (DQO) process, which is a systematic planning tool, based on the scientific method, for establishing criteria for data quality and for developing data-collection designs (EPA 1994a). The DQOs presented below have been developed to guide the Group 5 RD/RA. The process consists of seven iterative steps that yield a set of principal study questions and decision statements that must be answered to address a primary problem statement. The seven steps comprising the DQO process are listed below:

Step 1. State the problem

Step 2. Identify the decision

Step 3. Identify the inputs to the decision

Step 4. Define the study boundaries

Step 5. Develop decision rules

Step 6. Specify limits on the decision

Step 7. Optimize the design for obtaining data.

The DQOs that govern the Group 5 plume evaluation and long-term monitoring are presented separately in the following sections. These objectives were negotiated with, and have the concurrence of, the Agencies.

2.1.1 Plume Evaluation DQOs

The following sections present details on each of the DQO steps to be answered by the work conducted under this FSP. A summary of the HI interbed evaluation DQOs is presented in Table 2-1.

2.1.1.1 State the Problem. The WAG 3 ROD (Section 8, page 8-3) established an RAO for the SRPA as follows: "In 2095 and beyond, (to) ensure that SRPA groundwater does not exceed a cumulative carcinogenic risk of 1×10^{-4}, a total, hazard index of 1; or applicable State of Idaho groundwater quality standards (i.e., MCLs)." Group 5 of WAG 3 is defined as that portion of the SRPA outside of the current INTEC fence line bounded by the contaminant plume that currently exceeds Idaho groundwater quality standards or the federal MCLs for I-129, H-3, and Sr-90. Based upon the above RAO for groundwater, a remediation goal (RG) for Group 5 was also established in the ROD (Section 8.1.5, pages 8-10). The RG is to achieve the applicable State of Idaho groundwater standards or risk-based groundwater concentrations in the SRPA plume south of the INTEC security fence by the year 2095.

The ROD also establishes the means of achieving this goal through a phased approach. The first phase would determine if model-derived action levels for COCs are exceeded. The second phase occurs if the action levels are exceeded. In that case, a contingent pumping and treatment action will be implemented to remove sufficient contaminants to facilitate aquifer restoration by 2095 (ROD, Section 8.1.5, pages 8–10). This drilling program is required to determine if current groundwater concentrations for COCs exceed the modeled action levels and, if they do, can sufficient volume and production rates be achieved by a residential water supply well that would pose a risk to the future groundwater user in the year 2095 and beyond.

Data collected from the drilling program also may be of benefit in the calibration and validation of the present groundwater contaminant predictive model. The model indicates that the principal risk to future groundwater users in the SRPA outside the INTEC facility boundary is the I-129 concentrations in the SRPA (ROD Table 7-8, pages 7–26). From the WAG 3 FSS (DOE-ID 1998) modeling, peak concentrations of I-129 are predicted to remain above MCLs after 2095 in the HI sedimentary interbed while water in the bulk of the aquifer will be below the I-129 MCLs by 2095. However, no empirical data are available to confirm the physical properties of the HI interbed as assumed in the WAG 3 model nor is there any data regarding the presence or absence of high concentrations of I-129 in the interbed. Empirical evidence is required to refine the model predictions and determine whether or not an acceptable risk from I-129 is predicted to exist in 2095 and beyond.

2.1.1.2 Identify the Decisions. This step lays out the principal study questions (PSQs), alternative actions (AAs), and corresponding decision statements that must be answered to effectively address the above stated problem.

2.1.1.2.1 Principal Study Questions—The purpose of the PSQ is to identify key unknown conditions or unresolved issues that, when answered, provide a solution to the problem being investigated, as stated above. The PSQs for this project are as follows:

PSQ-1: Are COC concentration action levels exceeded in the model-predicted hot spot of the groundwater-contaminant plume located to the south of the INTEC facility security fence, and do COCs exceed the concentration action levels anywhere vertically within the groundwater-contaminant plume located to the south of the INTEC security fence?

PSQ-2: Do any zones that exceed COC action levels identified in PSQ-1 yield a sustained flow of greater than 0.5 gpm for a period of 24 hours?

PSQ-3: Does the hot spot exceed the volume action level such that a residential water user may pump from the hot spot for a period of more than one year?

2.1.1.2.2 Alternative Actions—AA are those actions that could possibly result from the resolution of the above PSQs. The types of AA considered will depend on the answers to the PSQs.

AA-1: Based on data indicating the degree of contamination, the alternatives to PSQ-l include proceeding to actions required to define PSQ-2 or to proceed with periodic monitoring.

AA-2: Based on data collected during a 24-hour-pumping test, the alternatives to PSQ-2 include proceeding to actions required to define PSQ- 3 or to proceed with periodic monitoring.

AA-3: Based on volume determinations, the alternatives to PSQ-3 include proceeding to contingent remediation or proceeding with periodic monitoring.

2.1.1.2.3 Decision Statements—The decision statements (DSs) combine the PSQ and AA into a concise statement of action. The DS for each of the PSQs is stated below.

DS-1: Determine whether COC concentration action levels are exceeded in the model-predicted hot spot downgradient of INTEC, requiring additional evaluation of the aquifer water yield from the hot spot.

Table 2-1. Data quality objectives table for OU 3-13, Group 5, Snake River Plain Aquifer.

Problem Statement A: HI Interbed Contingent Remedy Decision					
1: State the Problem	**2: Identify the Decision**			**3: Identify Inputs to the Decision**	**4. Define the Study Boundaries**
	Principal Study Questions	**Alternative Actions**	**Decision Statement**		
Problem Statement A: Empirical data are required to support refinement of the WAG 3 SRPA numerical model to determine if, following model refinement, we continue to predict a risk to future groundwater users post-2095 due to I-129 potentially present in the HI sedimentary interbed. **NOTE:** Modeling of the SRPA for the WAG 3 RI/FS predicted a future risk to groundwater users due to high concentrations of I-129 predicted to be present in the low-hydraulic conductivity HI sedimentary interbed in the year 2095 and beyond. However, no empirical data are available to confirm the physical properties of the HI interbed as assumed in the WAG 3 model nor is there any data regarding the presence or absence of high concentrations of I-129 in the interbed. Empirical evidence is required to refine the model predictions and determine whether or not an acceptable risk from I-129 is predicted to exist post-2095.	PSQ-1: Are COC concentration action levels exceeded in the model-predicted hot spot of the groundwater-contaminant plume outside of the INTEC security fence? **NOTE:** The action level(s) is based on groundwater modeling and will correspond to COC concentrations that will not exceed risk concentrations greater than 1×10^{-4} or MCLs in the year 2095. COC concentration data will be obtained from the HI interbed and surrounding basalts during the field sampling program anticipated to occur in FY 2001. Modeling predictions are required to determine if these action levels will be exceeded in 2095. The combined COC action level for H-3, Sr-90, and I-129 (beta –gamma-emitters) is 4 mrem/yr in the year 2095.	AA-1: Alternatives to PSQ-1 include proceeding on to actions required to answer PSQ-3 or lapsing into SRPA monitoring.	DS-1: Determine whether COC concentration action levels are exceeded in the model-predicted hot spot downgradient of INTEC requiring additional evaluation of the aquifer-water yield from the hot spot.	The inputs to PSQ-1 are as follows: • Groundwater model sensitivity analysis of the HI sedimentary interbed characteristics to identify key variables related to HI interbed for long-term predictions of COC concentrations. • Establishing four new wells and/or boreholes in the RI/FS modeled I-129-hot spot and the MSIP modeled I-129-hot spot for groundwater and sedimentary interbed sampling. • Physical characteristics of the HI sedimentary interbed, (identified in the aquifer-model sensitivity analysis), to support model refinement and COC concentration predictions. • Borehole geophysical and fluid logging of four deepened wells, three existing wells, and one new well for location of sampling depths. • Vertical profile sampling (straddle packer) of new wells/boreholes and existing wells for COC concentrations at, above, and below the HI interbed. • A baseline sampling round of 47-aquifer-monitoring wells for I-129, H-3, and Sr-90 to support model refinement and COC concentration predictions. • Model refinement and updated prediction of COC concentrations in 2095 and beyond.	This study will focus on physical characteristics of the HI sedimentary interbed and peak concentrations and distribution of groundwater COCs within the SRPA groundwater contaminant plume south of INTEC. The purpose of the study is to determine if the WAG 3 RI/FS aquifer model is correct in predicting that there will be an unacceptable risk to residential groundwater users outside of the INTEC fence line in excess of 1×10^{-4} (or COCs exceeding MCLs) in the year 2095 and beyond. The potential risk is primarily from I-129, which is predicted by the aquifer model to reside in the HI interbed at concentrations exceeding the RG. The spatial boundary of this study is limited to the area defined as Group 5, SRPA, under the OU 3-13 ROD. This encompasses that portion of the SRPA outside of the INTEC security fence bounded by the groundwater contaminant plume that exceeds Idaho groundwater quality standards of the federal MCLs for I-129, H-3, or Sr-90. Based upon the WAG 3 groundwater model, the area of particular interest within this boundary is an I-129 hot spot south of INTEC in the vicinity of well USGS-113. (**NOTE:** This may be refined by prefield testing sensitivity analysis of HI interbed in the WAG 3 aquifer model.) The estimated depth of the HI interbed in this area is between 100 and 140 ft below the water table, though the aquifer above, within, and below the HI interbed is included in this study. The base of the study area will be the first high permeability zone in the I basalt below the HI interbed, but not to exceed 100 ft below base of HI interbed. The hot spot is predicted to exist within the HI sedimentary interbed below the water table at this location. However, to date, empirical evidence has not been collected that supports the existence of this hot spot, nor has a sensitivity analysis been performed on the WAG 3 model's representation of the HI interbed that resulted in the prediction. It should be noted that practical constrains on the collection of soil and groundwater samples (i.e., poor sample recovery, limitation on packer deployment in rubbley or cavernous zones, etc.) may limit our ability to sample the interbed or SRPA in general at certain zones.
	PSQ-2: Do zones which exceed COC action levels identified in PSQ-1 yield a sustained flow of greater than 0.5 gpm for a period of 24 hours?	AA-2: Alternatives to PSQ-2 included proceeding to actions required to answer PSQ-3 or lapsing into SRPA monitoring.	DS-2: Determine if the hot spot will yield a groundwater-flow rate of 0.5 gpm for a period of 24 hours.	If the COC action levels are exceeded in PSQ-1, then the inputs to PSQ-2 will be as follows: • A 24-hour/0.5-gpm pumping test(s) of the zones which were identified in PSQ-1 as having COC(s) which exceeded action level(s) • Sampling of the COC(s) during the pumping test.	This study will be used to determine if contingent groundwater remediation is required to reduce the risk to future groundwater users in the year 2095 and beyond. Thus the current decision of whether or not to implement the contingent remedy will rely on predicted concentrations of COCs as calculated by the refined WAG 3 aquifer model. Prior to 2095, institutional controls will be in place to prevent residential use of groundwater exceeding MCLs or 1×10^{-4} risk concentrations.
	PSQ-3: Does the hot spot exceed the volume-action level such that a residential water user may pump from the hot spot for a period of more than 1 year?	AA-3: Alternatives to PSQ-3 include proceeding on to the contingent remedy and aquifer monitoring or just lapsing into SRPA monitoring.	DS-3: Determine if the hot spot is of sufficient size/volume to require contingent remediation.	If required, the inputs to PSQ-3 will be as follows: • An analytical or model-derived volume action level • Evaluation of the COC hot spot volume through the creation of iso-surface maps to calculate the estimated volume.	

Table 2-1. (continued).

Problem Statement A: HI Interbed Contingent Remedy Decision		
5: Develop a Decision Rule	6: Specify Tolerable Limits on Decision Errors	7: Optimize the Design
DS-1: If any COC exceeds its action level at any sampling zone, then we must determine if the aquifer at that zone is also capable of producing a sustained yield of 0.5 gpm for a period of 24 hours. If COC action levels are not exceeded at any sampling location then we will proceed with SRPA monitoring (i.e., periodic monitoring).	To be determined.	A flow chart presenting the conceptual design of the WAG 3 Group 5 field activities is attached as Figure 2-1 titled "Project flow chart showing conceptual design of field activities." The flow chart details the steps to be taken to both arrive at a contingent remedy decision and to perform the SRPA interim monitoring. The two separate flow paths are identified on the chart. The following paragraphs describe and present the rationale for the design of field activities related to the contingent remedy decision. The Group 5 decision to collect additional COC concentration and SRPA and interbed data prior to making a decision on implementation of the contingent remedy is based upon the need to evaluate the WAG 3 RI/FS model predictions of elevated I-129 concentrations in the SRPA, including the HI interbed, post-2095. Because no physical characteristics or COC concentration data were available from the HI interbed to confirm the model predictions and no sensitivity analysis has been performed, we must collect empirical data on the presence of I-129 in the SRPA and physical properties of the HI interbed south of INTEC to support refinement of the groundwater model. Given the basis for the field activities prior to conducting the field activities, available field data will be reviewed and a sensitivity analysis on the HI interbed assumptions will be performed. This activity will be performed to identify hydrologic data gaps which will be incorporated in the final sampling and analysis plan for the Group 5 contingent remedy decision. This work will also be used to refine the predicted I-129 hot spot location, select existing wells for sampling (if any) and to determine if additional wells are required and their locations. Based upon evaluation of the RI/FS modeling results and the MSIP modeling results, four new wells/boreholes will be constructed in the vicinity of the predicted and observed I-129-hot spots. The wells will be drilled in a manner that allows for the collection of sedimentary interbed samples from the HI interbed for analysis of physical characteristics and COC concentrations. Following drilling, borehole geophysical and fluid logging will be performed on the newly deepened wells (and three existing wells selected for profiling) to identify sampling locations for COC vertical profile sampling. The geophysical logging will consist of natural gamma, caliper, deviation, and video logging. Borehole fluid logging will consist of borehole flow, temperature, and specific conductivity. These logs will be reviewed prior to groundwater sample collection to identify the specific zones within each borehole for sampling. Groundwater sampling will be conducted using a packer system and sampling pump to isolate the specific zone being sampled. Except for the interbed sampling, one sample will be collected from each sampling zone. Because of concerns about borehole collapse or sloughing in the interbed, groundwater samples from the interbed will be collected during drilling. The borehole will be extended approximately 5 ft into the interbed and the first sample will be taken using a single packer system and will consist of packing off the basalt at the interbed basalt interface. A bottom packer will not be used for the interbed sample. To guard against equipment getting trapped in the hole, the pump will be placed above the packer and a screen placed below the packer in the interbed. Replicate samples for Tc-99 and I-129 will be collected during interbed sampling. The replicate Tc-99 samples will be analyzed and the replicate I-129 sample held in storage until the results are determined for the I-129 and Tc-99 samples. The replicate samples will be analyzed for Tc-99 to confirm the original sample results. If I-129 is above the action level, the replicate I-129 sample from the interbed will be analyzed. An aquifer stress test, a slug test, will also be performed at the time of sampling. Following sample collection and analysis, the data will be reviewed to determine if the COC action levels are exceeded in any sampling zone. If the COC action level is exceeded in a zone, the zone will again be isolated with packers and pumped for a period of 24 hours to determine if the zone will yield groundwater at a rate of 0.5 gpm for the duration of the test. One water sample will be collected every 4 hours during pumping to determine if the COC action levels are also exceeded throughout the pumping test. If COC action levels are exceeded and the aquifer at the sampling zone(s) yields a sustained 0.5 gpm for a 24-hour period, isopleth maps will be developed from the COC concentration data to estimate the volume of the hot spot(s). It is possible that additional wells may be required estimate the hot spot volume. If additional wells are determined necessary, they will be drilled and then tested in the same manner as described above. The final volume estimates will be compared to the model-derived volume action level to determine if it has been exceeded. These results will be reported in the Group 5 monitoring report/decision summary. To assist in the model evaluation and COC predictions discussed above, and to up date information on COC plume dynamics subsequent to the 1991 USGS sampling event, samples will be collected from the existing aquifer monitoring well network and analyzed for COC concentrations. This sampling will provide additional data to support model predictions of how the aquifer is performing outside of the HI interbed and support refining of the model predictions. A first round of sampling will be performed including the full INTEC monitoring network (47 wells), with subsequent annual monitoring performed on a limited set of wells (approximately 20) specifically identified to support an updated aquifer model calibration. Following completion of the monitoring report/decision summary, periodic monitoring of the WAG 3 groundwater plume(s) outside of the INTEC security fence line will be implemented. This periodic monitoring of the plumes will be performed concurrent with the INTEC facility monitoring.
DS-2: If the aquifer is capable of producing 0.5 gpm for a period of 24 hours from a zone which also exceeds COC action levels, then we must determine the volume of the hot spot. If the zone does not produce 0.5 gpm for 24 hours then we will proceed with SRPA monitoring.		
DS-3: If the volume of the COC hot spot is sufficiently large that a future groundwater user could pump from the hot spot for a period of more than 1 year then we are required to proceed with the contingent remedy. If the hot spot does not exceed the volume action level then we will proceed with SRPA monitoring.		

Table 2-1. (continued).

Problem Statement B: INTEC Facility Monitoring					
1: State the Problem	**2: Identify the Decision**			**3: Identify Inputs to the Decision**	**4. Define the Study Boundaries**
	Principal Study Questions	**Alternative Actions**	**Decision Statement**		
Problem Statement B: Monitor the flux of contaminants in the aquifer across the INTEC security fence line and downgradient of the facility to determine if the Group 5 RAO of achieving Idaho groundwater quality standards or risk-based concentrations by 2095 will be affected by contamination within the INTEC facility. OU 3-13 Group 5 is defined as the portion of the SRPA outside of the INTEC security fence where concentrations of COCs exceed current MCLs or risk-based concentrations. The RG for OU 3-13, Group 5, is "Achieving the applicable State of Idaho groundwater standards or risk-based groundwater concentrations in the SRPA plume south of the INTEC security fence by the year 2095" (ROD, Section 8.1.5, pages 8–10). To determine if this goal will be met, the input of contaminants to Group 5 from the contaminated aquifer within the INTEC security fence must be determined.	PSQ-1: Is the COC flux in the SRPA from the contaminated media in the vadose zone beneath the INTEC facility of sufficient magnitude to prevent achieving the Group 5 RGs?	No alternative actions required for monitoring program	DS-1: Determine whether or not the flux of contaminants in the SRPA which originate in the vadose zone within the INTEC security fence line is of sufficient magnitude to exceed the Group 5 RGs in 2095.	The following are inputs to PSQ-1: 1. Sampling of selected wells upgradient of, near the boundary, and within the INTEC security fence line and analysis for COCs. Selected wells will be sampled in the upper 50 ft of the SRPA. 2. Measurement of water table elevations for evaluation of groundwater elevation contours and flow direction. 3. Periodic incorporation of new data and update of the WAG 3 OU 3-13 aquifer numerical model for prediction of COC concentrations in the SRPA at 2095 and beyond.	This study will focus on the SRPA beneath the INTEC facility and near the boundary of the facility. The area of focus along the INTEC boundary is the south and west boundaries given the south-southwest direction of groundwater flow in this region. The primary sources of contaminants to the aquifer include both the perched water/vadose zone above SRPA and the former injection well which penetrates the aquifer and HI interbed. Two principal study questions have been identified to evaluate these sources separately. The portion of the aquifer that is likely to be affected by contaminants transported through the vadose zone is the upper 50 ft of the aquifer above the HI interbed. Because the former injection well penetrated the HI interbed, the portion of the aquifer potentially affected by the injection well includes both the upper zone from the water table to the HI interbed and the lower zone beneath the HI interbed. The total depth of the former injection well was 598 ft. Accordingly the base of the study boundary should correspond to the total depth of injection, or approximately 600 ft below land surface. Monitoring the concentrations of COCs above and below the HI interbed and as far downgradient as indicated by the detections of COCs above MCLs. Because the RG is established in the year 2095, this study will continue through the institutional control period to at least 2095.
	PSQ-2: Is the COC flux in the SRPA from the contaminated sediments/sludges remaining in the former ICPP injection well (CPP-23) and immediate vicinity of sufficient magnitude to prevent achieving the Group 5 RG?	No alternative actions required for monitoring program.	DS-2: Determine whether or not the flux of contaminants in the SRPA from the former INTEC injection well is of sufficient magnitude to exceed the Group 5 RGs in 2095.	The following are inputs to PSQ-2: 1. Borehole geophysical and fluid logging of selected wells which penetrate the HI interbed for selection of wells and sampling zones below the HI interbed for selection of wells and sampling zones below the HI interbed downgradient of the former injection well. 2. Isolation through packers or other method(s), sampling, and analysis for COCs of selected well zones below the HI interbed downgradient of the former injection well. 3. Measurement of water table elevations for evaluation of groundwater elevation contours and flow directions, and possibly head gradient between aquifer above and below the HI interbed. 4. Periodic incorporation of new data and update of the WAG 3 OU 3-13 aquifer numerical model for prediction of COC concentrations in the SRPA at 2095 and beyond. **NOTE:** Isolation of sampling zone(s) beneath the HI interbed depth from selected wells should not preclude also sampling of zone(s) above the HI interbed from the same well to supply inputs for PSQ-1.	
	PSQ-3: Are the COC concentrations in the SRPA outside the INTEC facility at sufficient magnitude to prevent achieving the Group 5 RGs?	No alternative actions required for monitoring program.	DS-3: Determine whether or not the COCs in the SRPA outside the INTEC facility will exceed the Group 5 RGs in 2095.	The following are inputs to PSQ-3: 1. Sampling of selected wells downgradient of the INTEC security fence and analysis for COCs. Selected wells will monitor contaminants above MCLs and monitor the downgradient plume area above MCLs. 2. Measurement of water elevations for evaluation of groundwater elevation contours and flow direction. 3. Periodic incorporation of new data into the OU 3-13 aquifer numerical model for the predication of COC concentrations in the SRPA in 2095 and beyond.	

Table 2-1. (continued).

5: Develop a Decision Rule	6: Specify Tolerable Limits on Decision Errors	7: Optimize the Design
If the monitoring activities and model predictions generated for this study indicate that Group 5 RAOs/remedial goals will be exceeded due to the flux of contaminants in the SRPA beneath or downgradient of the INTEC facility, a comprehensive evaluation, focused feasibility study, and ROD amendment will be performed to address the risks posed by groundwater contaminants beneath INTEC and/or downgradient of INTEC. If it is determined that the RAOs/remedial goals will be met, monitoring will continue until 2095 or until the agencies determine that no unacceptable risk exists from Group 5. Note: The decision is based upon model predictions using data obtained from an observational well network to model evolution of the plume.	In this case, the decisions will be made by comparing data to computer predictions; the accuracy of the computer predictions will be dependent on the accuracy of the OU 3-13 model.	A flow chart presenting the conceptual design of the WAG 3 Group 5 field activities entitled "Project flow chart showing conceptual design of field activities," is shown in Section 2, Figure 2-1. The flow chart details the steps to be taken to both arrive at a contingent remedy decision and to perform the SRPA interim monitoring. The two separate flow paths are identified on the chart. The following paragraphs describe and present the rationale for the design of field activities related to the contingent remedy decision. Thirty-six wells are available in the vicinity of INTEC suitable for groundwater monitoring. From that set of wells, 11 are selected for the INTEC facility monitoring program to support PSQ-1, monitoring of the contaminant input from the vadose zone to the SRPA. The PSQ-1 INTEC facility monitoring shall consist of groundwater sample collection from wells located upgradient of, within, and adjacent to the INTEC facility. The wells selected for monitoring include MW-18, USGS-40, USGS-42, USGS-47 through -49, USGS-51, USGS-52, and USGS-122 through USGS-123 (see Section 4, for a figure showing well locations). One well, USGS-121, was selected upgradient of the contaminant source areas at INTEC to provide background groundwater quality data. Though this well is not directly upgradient of the INTEC facility, it is located nearer to the groundwater flow paths from potential sources of upgradient contamination (TRA or NRF) than other wells and is, in that respect, well suited for providing upgradient water quality data. Several wells were selected inside the INTEC facility (MW-18, USGS-47, USGS-48, USGS-49, and USGS-52) to help distinguish between the possible sources of groundwater contaminants located throughout the INTEC facility. Wells USGS-40, USGS-42, USGS-51, USGS-122, and USGS-123 were selected because they are located along the southern and western boundaries of INTEC. The general direction of groundwater flow beneath INTEC is interpreted to be to the south-southwest. The selected wells are considered adequate for the INTEC facility monitoring and no new wells are considered necessary at this time. However, additional wells are currently planned for various other monitoring programs at INTEC. As these wells become available, they will be considered for inclusion into the INTEC facility monitoring program. The three wells selected for monitoring in support of PSQ-2, former injection well monitoring, are USGS-41, USGS-48, and USGS-59 based upon an evaluation of their suitability for monitoring the aquifer below the HI interbed. There are 12 USGS wells in the vicinity of INTEC and the former injection well that penetrate the HI interbed and remain as open boreholes in the aquifer, potentially suitable for long-term monitoring of the aquifer beneath the HI interbed (excluding INTEC production wells which are required for facility support and cannot be modified to sample below the HI interbed). The wells are USGS-40 through-49, USGS-51, USGS-52, and USGS-59. These wells are located either cross-gradient or downgradient of the former injection well. An evaluation of available data from and additional geophysical and borehole fluid logging of these wells will be performed to determine if they are suitable for deep sampling and to identify potential zones for sampling. It should be noted that an upgradient monitoring well which penetrates the HI interbed is not available within the existing monitoring well network at INTEC. Well USGS-121 does not penetrate the HI interbed. Production wells CPP-1, CPP-2, and CPP-4 have been drilled through the HI interbed and have perforated well-casing both above and below the HI interbed but are of limited use as monitoring wells based upon their required support of INTEC operations. The need for an upgradient monitoring well in this zone will be evaluated after the monitoring program is initiated. If the data obtained from the facility monitoring program indicate that the injection well secondary source may cause or contribute to not meeting the Group 5 RAO/RGs, an upgradient well will be installed for sampling beneath the HI interbed to ensure that an upgradient source is not present. It should also be noted that current plans for OU 3-14 investigation include the installation of monitoring well in the immediate vicinity of the former injection well. As these well(s) become available, they will be incorporated into the INTEC facility monitoring well program to provide additional data in the vicinity of the injection well secondary source. In addition to the above monitoring, one sampling round will be conducted using the entire INTEC monitoring network at the onset of the activities outlined in the LTMP. This sampling event will provide a "snapshot" of the current state of the contamination of the SRPA in the vicinity of the INTEC facility and provide a data set to compare the COC flux monitoring data. In addition, these data will be used to update the OU 3-13 numerical aquifer model. In support of Group 4 activities, groundwater samples collected during the baseline sampling event from USGS-40, -42, -47, -48, -49, -51, -121, -122, -123, and MW-18 will be analyzed for stable isotopes including oxygen, hydrogen, and nitrogen. In addition to the analytes listed below, metals and anions will be included in the semiannual and micropurge sampling. Six wells have been selected for long-term monitoring of the INTEC plume beyond the facility boundary in support of PSQ-3. The wells selected for long-term monitoring are USGS-57, USGS-67, USGS-112, USGS-113, USGS-85, and LF3-08. These wells were selected based on a review of the historical data for I-129. However, most of the data used to select these wells for long-term monitoring is from 1990–1991; therefore, the baseline groundwater sampling data will be used to optimize the well locations and the total number of wells for long-term monitoring. Analytes of interest include COCs which currently exist in the SRPA at concentrations exceeding either MCLs or risk-based concentrations as well as COCs derived from the modeling which are predicted to potentially cause a future unacceptable risk to the SRPA. Contaminants that currently exceed MCLs or risk-based concentrations and will be included in the INTEC facility monitoring program are I-129, H-3, and Sr-90. Contaminants that are predicted by the WAG 3 RI/FS modeling to exceed MCLs or risk-based concentrations at a future date and are included in the INTEC facility monitoring program are plutonium and uranium isotopes, Np-237, Am-241, and mercury. Chromium, while listed as a COC, is excluded because it is specifically related to groundwater contamination at TRA. Also, because Tc-99 is a contributor to total beta-emitting radionuclides limit and present at significant concentrations in the aquifer beneath INTEC, it is included in the list of analytes for INTEC facility monitoring. To evaluate additional radionuclides that may be present but not accounted for in the modeling, gross-alpha and gross-beta analyses will also be performed. Finally, the list of analytes will be updated through either the exclusion of some analytes or inclusion of additional analytes as analytical data are accumulated or new information regarding contaminant sources is identified. The detection limits for I-129, Sr-90, and tritium required to make the decisions needed concerning the contingent remedy are 0.1 pCi/L, 0.8 pCi/L and 2000 pCi/L, respectively. Sampling and analyses will occur at the following frequency: Year 1 — Baseline and Semiannual — Gross-alpha/beta, Hg, tritium, Tc-99, I-129, Sr-90, plutonium isotopes (Pu-238, -239, -240, and –241), uranium isotopes (U-234, -235, and -238), Am-241, Np-237, Cs-137; metals and anions in semiannual and micropurge sampling only. Years 2–7 — Annual — Gross-alpha/beta, Hg, tritium, Tc-99, I-129, Sr-90, plutonium isotopes (Pu-238, -239, -240, and –241), uranium isotopes (U-234, -235, and –238), Am-241, Np-237, Cs-137 Years 8–16 — Biannual (once every two years) — Review and adjust as required Years 17–100 — Once every 5 years — Review and adjust as required Following each sampling event and prior to each CERCLA 5-year review, the new groundwater sampling results will be compared against the OU 3-13 aquifer model predictions to determine if concentrations are above, at, or below the model-predicted trends. If the new data indicate the model must be updated, the model will be updated generating new COC concentration predictions. These predictions will be compared against the Group 5 RAO/ RGs to determine if they will be exceeded or not. If the data trends exceed model-predicted trends and indicate a potential exceedance of the Group 5 RAO/RGs, the sampling frequency will revert to annual sampling and progress in a manner similar to the schedule above.

DS-2: Determine if the hot spot will yield a groundwater flow rate of 0.5 gpm for a period of 24 hours, requiring additional evaluation of the aquifer water hot spot volume.

DS-3: Determine if the hot spot is of sufficient size/volume to require contingent remediation. This step identifies the informational inputs that are required to answer the DS made above.

2.1.1.2.4 Inputs for PSQ-1—

1. Groundwater model sensitivity analysis of the HI sedimentary interbed characteristics to identify key variables related to HI interbed for long-term predictions of COC concentrations

2. Four additional well/boreholes will be installed in the vicinities of the RI/FS modeled hot-spot and the MSIP modeled hot-spot I-129 hot spots for groundwater and sedimentary interbed sampling

3. Physical characteristics of the HI sedimentary interbed (saturated hydraulic conductivity, bulk density, grain size, distribution, and porosity estimate) will be identified in the aquifer model sensitivity analysis to support model refinement and COC concentration predictions

4. Borehole geophysical and fluid logging of the new wells and three existing wells for location of sampling depths

5. Vertical profile sampling (straddle packer) of four deepened wells, three existing wells, and one new well for I-129, H-3, and Sr-90 concentrations at, above, and below the HI interbed

6. A baseline sampling round of 47-aquifer-monitoring wells for I-129, H-3, and Sr-90 to support model refinement and COC concentration predictions

7. Model refinement and updated prediction of COC concentrations in 2095 and beyond.

2.1.1.2.5 Inputs for PSQ-2—If the COC action levels are exceeded in PSQ-1, then a pumping test will be conducted to determine if the hot spot zone will yield groundwater at a rate of 0.5 gpm for a period of 24 hours. The zone(s) exceeding action levels as determined by sampling performed for PSQ-1 will be pump-tested for a 24-hour period. During the pumping test, discharge water will be sampled to determine if COC concentrations exceed the action level throughout the pumping period. Thus, the inputs for PSQ-2 are

1. A 24-hour/0.5-gpm pumping test(s) of the zones that were identified in PSQ-1 as having COC(s) that exceeded action level(s)

2. Sampling of the discharge water for COC(s) during the pumping test.

2.1.1.2.6 Inputs for PSQ-3—If the results of studies performed for PSQ-1 and PSQ-2 indicate that further action is necessary, PSQ-3 will be implemented to determine what the volume of the hot spot(s) is and whether the volume of the hot spot will sustain pumping for a period of one year. The volume action level will need to be determined based upon either analytical or numerical modeling techniques. Three-dimensional isopleth maps will be prepared from this information to estimate the volume of the hot spot that exceeds the COC action levels. Therefore, if required, the inputs to PSQ-3 will be

1. An analytical or model-derived volume action level

2. Evaluation of the COC hot spot volume through the creation of iso-surface maps to calculate the estimated volume.

2.1.1.3 Define the Boundaries of the Study.
This study will focus on physical characteristics of the HI sedimentary interbed and peak concentrations and distribution of groundwater COCs within the SRPA groundwater contaminant plume south of INTEC. The purpose of the study is to determine if the WAG 3 RI/FS aquifer model is correct in predicting that there will be an unacceptable risk to residential groundwater users outside the INTEC fence line in excess of 1×10^{-4} or COCs exceeding MCLs in the year 2095 and beyond. The potential risk is primarily from I-129, which is predicted by the aquifer model to reside in the HI interbed at concentrations exceeding the RG.

The spatial boundary of this study is limited to the area defined as Group 5, SRPA, under the OU 3-13 ROD. This encompasses that portion of the SRPA outside the INTEC security fence bounded by the groundwater contaminant plume that exceeds Idaho groundwater quality standards and the federal MCLs for I-129, H-3, or Sr-90. Based upon the WAG 3 groundwater model, the area of particular interest within this boundary is an I-129 hot spot south of INTEC in the vicinity of USGS-113 Well. The estimated depth of the HI interbed in this area is between 30 and 43 m (100 and 140 ft) below the water table, though the aquifer above, within, and below the HI interbed is included in this study. An additional area of interest lies further south near the CFA landfill wells (LF2 and LF3 series) where MSIP modeling indicates elevated I-129 concentrations. The base of the study area will be the first high permeability zone in the I basalt below the HI interbed, but not to exceed 30 m (100 ft) below base of HI interbed. The hot spot is predicted to exist within the HI sedimentary interbed below the water table at this location. However, to date, empirical evidence has not been collected that supports the existence of this hot spot, nor has a sensitivity analysis been performed on the WAG 3 model of the HI interbed that resulted in the prediction.

It should be noted that practical constraints on the collection of soil and groundwater samples (i.e., poor sample recovery, limitations on packer deployment in highly fractured or cavernous zones, etc.) may limit our ability to sample the interbed or SRPA at certain zones. This study will be used to determine if contingent groundwater remediation is required to reduce the risk to future groundwater users in the year 2095 and beyond. Thus, the current decision of whether to implement the contingent remedy will rely on predicted concentrations of COCs as calculated by the refined WAG 3 aquifer model.

Prior to 2095, institutional controls will be in place to prevent residential use of groundwater exceeding MCLs or 1×10^{-4} risk concentrations.

2.1.1.4 Develop a Decision Rule.
This step brings together the outputs from Steps 1 through 4 into a single statement describing the basis for choosing among the listed alternatives. The decision rules guiding this investigation are basically set forth in Figure 11-6, on page 11-24 of the WAG 3 ROD (DOE-ID 1999). Three criteria must be met prior to a positive decision to implement contingent remediation:

Decision Rule (DR)-l: If any COC exceeds its action level at any sampling zone, then we must determine if the aquifer at that zone is also capable of producing a sustained yield of 0.5 gpm for a period of 24 hours. If COC action levels are not exceeded at any sampling location, then we will proceed with SRPA monitoring (i.e., periodic monitoring).

DR-2: If the aquifer is capable of producing 0.5 gpm for a period of 24 hours from a zone that also exceeds COC action levels, then we must determine the volume of the hot spot. If the zone does not produce 0.5 gpm for 24 hours, then we will proceed with SRPA monitoring.

DR-3: If the volume of the COC hot spot is sufficiently large such that a future groundwater user could pump from the hot spot for a period of more than one year, then we are required to proceed with the contingent remedy. If the hot spot does not exceed the volume-action level, then we will proceed with SRPA long-term monitoring.

2.1.1.5 Specify Tolerable Limits on Decision Errors. Five types of new information may be collected or developed during this study: (1) laboratory analytical data from groundwater samples, (2) borehole geophysical logs, (3) aquifer test results, (4) groundwater numerical modeling results, and (5) sedimentary interbed physical charcterization (i.e., saturated hydraulic conductivity, bulk density, grain size distribution, and porosity). Because of the nature of logging and aquifer testing studies, statistically based decision error limits are not applicable and not required. Modeling information derived from the analytical data will not be directly amenable to statistical evaluation. Standard modeling error evaluation will be utilized to review the modeling results.

Laboratory analytical data collected during this study to determine if an action level is exceeded are amenable to statistically based limits on decision errors. Hypothesis testing will be utilized to determine if an action level is exceeded at any sampling point to resolve PSQ-1. The recommended null hypothesis, H_0, is that the true mean groundwater concentration for each COC is greater than or equal to the action level. The alternative hypothesis is that the mean is less that the action level:

$$H_0: \mu \geq \text{Action Level}$$

$$H_a: \mu < \text{Action Level}.$$

This hypothesis testing will be based upon small sample statistics (n<30; where n is the total number of measurments) and utilize the t-test statistic:

$$\text{Test Statistic: } t = \frac{\bar{x} - hypothesized value}{s / \sqrt{n}}.$$

Using this test statistic and hypothesis, we would reject the null hypothesis (and thereby accept the alternative hypothesis) if the test statistic t is less than the negative value of the t critical value obtained from standard math tables, given our number of samples and desired level of significance. This hypothesis testing will be performed to a level of significance, or α, of 0.05. In other words, with this level of significance and null hypothesis, we limit the probability of a Type 1 error, or of rejecting the null hypothesis when it is in fact true, to only 5%. The proposed hypothesis testing is designed to allow us to control the probability of erroneously concluding that COC action levels are not exceeded when in fact they are exceeded. This null hypothesis was formulated based upon our belief that the harmful consequences of incorrectly concluding that an action level is not exceeded, when it actually is, is greater than the consequences of incorrectly concluding that the action level is exceeded when in fact it is not.

2.1.1.6 Optimize the Design. A project flowchart, presenting the conceptual design of the WAG 3 Group 5 field activities, is shown in Figure 2-1. The flowchart details the steps to be taken to both arrive at a contingent remedy decision and to perform the SRPA interim monitoring. The two separate flow paths are identified on the chart. The following paragraphs describe the rationale for the design of field activities related to the contingent remedy decision. The Group 5 decision to collect additional COC concentration and SRPA and interbed data prior to making a decision on implementation of the contingent remedy, is based upon the need to evaluate the WAG 3 RI/FS model predictions of elevated I-129 concentrations in the SRPA, including the HI interbed, in 2095 and beyond. Because no physical characteristics or COC concentration data were available from the HI interbed to confirm the model

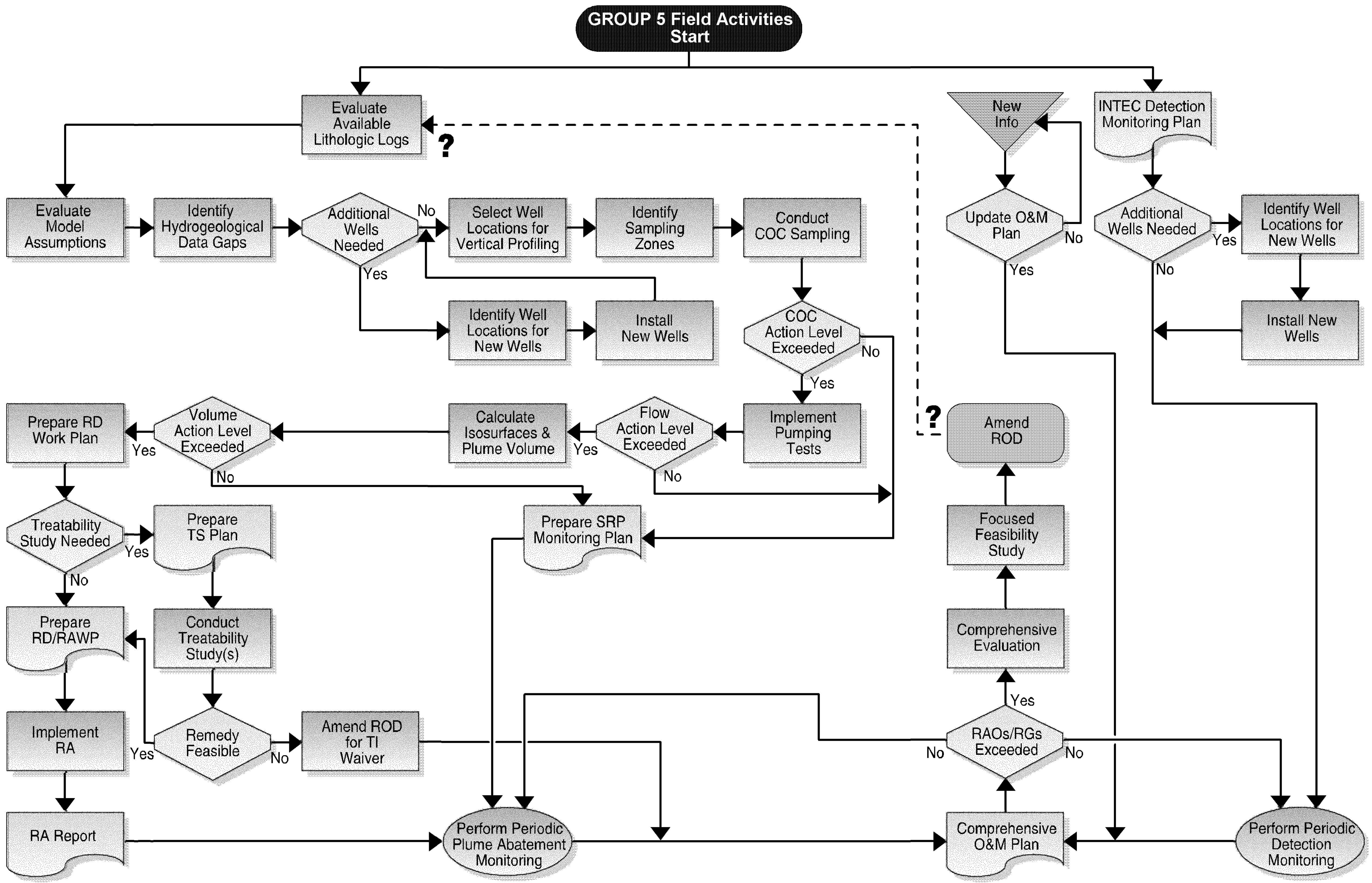

Figure 2-1. Project flow chart showing conceptual design of field activities.

predictions, and no sensitivity analysis has been performed, we must collect empirical data on the presence of I-129 in the SRPA and physical properties of the HI interbed south of INTEC to support refinement of the groundwater model.

Presently, there are no wells inside the hot spots that penetrate to or through the HI interbed. The criterion for placement of the new wells/boreholes will be based upon the RI/FS modeled I-129-hot spot and the MSIP modeled hot spot. To address the project DQOs, it is necessary to collect data in interbed geophysical parameters, the HI interbed thickness, aquifer water COC concentrations, and aquifer conductivity. To collect these data, four additional wells/boreholes will be installed by coring through the HI interbed to the first zone of high permeability in the I basalt flow ('I' is the nomenclature for basalt flow located beneath the HI interbed stratigraphic unit) (Anderson and Lewis 1991) below the HI interbed, but not to exceed 30 m (100 ft) below the interbed base.

Groundwater sampling will be conducted using a packer system and sampling pump to isolate the specific zone being sampled. Except for the interbed samples, one sample will be collected from each sampling zone. Because of concerns about borehole collapse or sloughing in the interbed, water samples from the interbed will be collected on the way down during drilling. The borehole will be extended approximately 1.5 m (5 ft) into the interbed. The first sample will be taken using a single packer system and will consist of packing off the basalt at the interbed basalt interface. A bottom packer will not be used for the interbed sampling. To guard against equipment getting trapped in the hole, the pump will be placed above the packer and a screen placed below the packer in the interbed. Replicate samples for Tc-99 and I-129 will be collected during interbed sampling. The replicate Tc-99, samples will be analyzed and the replicate I-129 sample held in storage until the results are determined for the I-129 and Tc-99 samples. The replicate samples will be analyzed for Tc-99 to confirm the original sample results. If I-129 is above the action level, the replicate I-129 sample will be analyzed. An aquifer-stress test (a slug test) will also be performed at the time of sampling.

Following sample collection and analysis, the data will be reviewed to determine if the COC action levels are exceeded in any sampling zone. If the COC action level is exceeded in a zone, the zone will again be isolated with packers and pumped for a period of 24 hours to determine if the zone will yield groundwater at a rate of 0.5 gpm for the duration of the test. One water sample will be collected every four hours during pumping to determine if the COC action levels are also exceeded throughout the pumping test.

If COC action levels are exceeded and the aquifer at the sampling zone(s) yields a sustained 0.5 gpm for a 24-hour period, isopleth maps will be developed from the COC concentration data to estimate the volume of the hot spot(s). It is possible that additional wells may be required to estimate the hot spot volume. If additional wells are determined necessary, they will be drilled and then tested in the same manner as described above. The final volume estimates will be compared to the model-derived volume action level to determine if it has been exceeded. These results will be reported in the Group 5 monitoring report/decision summary.

2.1.2 Long-Term Monitoring DQOs

The following sections present details on each of the DQO steps to be answered by the work conducted under this LTMP. A summary of INTEC facility monitoring DQOs is presented in Table 2-1.

The possibility of COC flux in the SRPA originating from sources within INTEC, either in the vadose zone or in the vicinity of the former INTEC injection well, must be quantified. The concentration of contaminants downgradient of INTEC also needs to be monitored. These data can be used to update and refine the OU 3-13 numerical groundwater model to better predict the state of the aquifer in 2095.

2.1.2.1 *Identify the Decision.* This step of the DQO process lays out the principal study questions, alternative actions, and corresponding decision statements that must be answered to effectively address the problem stated above. The RG for OU 3-13, Group 5 is "Achieving the applicable State of Idaho groundwater standards or risk-based groundwater concentrations in the SRPA plume south of the INTEC security fence by the year 2095" (ROD, Sec. 8.1.5, pg 8-10). To determine if this goal will be met, the input of contaminants to Group 5 from the contaminated aquifer within the INTEC security fence and the distribution of contaminants in the aquifer outside the INTEC security fence must be determined. To further assist in this evaluation, the groundwater modeling conducted as part of the OU 3-13 RI/FS will be utilized and refined with data collected under this LTMP.

2.1.2.1.1 *Principal Study Questions—*The purpose of the PSQ is to identify key unknown conditions or unresolved issues that, when answered, provide a solution to the problem being investigated. The PSQs for this project are the following:

PSQ-1: Is the COC flux in the SRPA from the contaminated media in the vadose zone within the INTEC security fence of sufficient magnitude to prevent achieving the Group 5 RGs (RGs)?

PSQ-2: Is the COC flux in the SRPA from the contaminated sediments/sludges remaining in the former ICPP injection well (CPP-3) and immediate vicinity of sufficient magnitude to prevent achieving the Group 5 RGs?

PSQ-3: Are the COC concentrations in the SRPA outside the INTEC facility of sufficient magnitude to prevent achieving the Group 5 RGs?

2.1.2.1.2 *Alternative Actions—*Alternative actions are those actions resulting from resolution of the above PSQs. The types of actions considered will depend on the answers to the PSQs.

2.1.2.1.3 *Decision Statements—*The DSs combine the PSQs and alternative actions into a concise statement of action. The DSs are

DS-1: Determine whether the flux of contaminants in the SRPA that originate in the vadose zone within the INTEC security fence is of sufficient magnitude to exceed the Group 5 RGs in 2095.

DS-2: Determine whether the flux of contaminants in the SRPA from the former INTEC injection well is of sufficient magnitude to exceed the Group 5 RGs in 2095.

DS-3: Detemine whether the COCs in the SRPA outside the INTEC facility will exceed the Group 5 RGs in 2095.

It is important to realize that the installation of an updated monitoring system and collection of new types of data during the SRPA monitoring might modify the site conceptual model for vadose zone flow and transport beneath WAG 3. If the conceptual model is significantly changed, DS-1 and DS-2 may need to be reevaluated accordingly.

2.1.2.2 *Identify Inputs to the Decision.* This step of the DQO process identifies the informational inputs that are required to answer the DSs made above.

2.1.2.2.1 *Inputs for PSQ-1—*PSQ-1 will be answered by collecting data on the COC flux originating in the vadose zone within the INTEC security fence, updating the OU 3-13 aquifer numerical model, and evaluating the predictions of the updated aquifer numerical model for COC concentrations in 2095.

Inputs to PSQ-1 are

1. Samples of selected wells upgradient of, near the boundary of, and within the INTEC security fence line, and analysis for COCs. Selected wells will sample in the upper 15 m (50 ft) of the SRPA.

2. Measurements of water table elevations for evaluation of groundwater elevation contours and flow direction.

3. Periodic incorporation of new data and update of the OU 3-13 aquifer numerical model for prediction of COC concentrations in the SRPA at 2095 and beyond.

2.1.2.2.2 Inputs for PSQ-2—PSQ-2 will be answered by collecting measurements of COC flux originating from the former injection well within the INTEC security fence, updating the OU 3-13 aquifer numerical model, and evaluating the predictions of the updated aquifer numerical model for COC concentrations in 2095.

Inputs to PSQ-2 are

1. Borehole geophysical and fluid logging of selected wells that penetrate the HI interbed for selection of wells and sampling zones below the HI interbed downgradient of the former injection well

2. Isolation through packers or other method(s), sampling, and analysis for COCs of selected well zones below the HI interbed downgradient of the former injection well

3. Measurements of water table elevations to contour of groundwater elevations and to determine flow direction, and possibly head gradient between the aquifer above and below the HI interbed

4. Periodic incorporation of new data and update of the OU 3-13 aquifer numerical model for prediction of COC concentrations in the SRPA in 2095 and beyond.

Isolation of sampling zone(s) beneath the HI interbed depth from selected wells should not preclude the sampling of zone(s) above the HI interbed from the same well to supply inputs for PSQ-2.

2.1.2.2.3 Inputs for PSQ-3—PSQ-3 will be answered by collecting measurements of COCs in the aquifer beyond the INTEC security fence line and by updating the OU 3-13 aquifer numerical model.

The inputs to PSQ-3 are

1. Sampling of selected wells downgradient of the INTEC security fence and analysis for COCs. Selected wells will monitor contaminants above MCLs and monitor the downgradient plume area above MCLs.

2. Measurement of water elevations for evaluation of groundwater elevation contours and flow direction.

3. Periodic incorporation of new data into the OU 3-13 aquifer numerical model for the prediction of COC concentrations in the SRPA in 2095 and beyond.

2.1.2.3 Define the Boundaries of the Study. This study will focus on the SRPA beneath INTEC, near the boundary of the facility and downgradient of the facility. The area of focus is the south and west boundaries because of the south-southwest direction of groundwater flow in this region.

The primary sources of contaminants to the aquifer include both the perched water/vadose zone above SRPA and the former injection well that penetrates the aquifer and HI interbed. Two PSQs have been identified to evaluate these sources separately.

The portion of the aquifer that is likely to be affected by contaminants transported through the vadose zone is the upper 15 m (50 ft) of the aquifer above the HI interbed.

Because the former injection well penetrated the HI interbed, the portion of the aquifer potentially affected by the injection well includes both the upper zone from the water table to the HI interbed and the lower zone beneath the HI interbed. The total depth of the former injection well was 182 m (598 ft). Accordingly, the base of the study boundary should correspond to the total depth of injection, or approximately 183 m (600 ft) bgs.

The third PSQ addresses monitoring of contaminants already present in Group 5 downgradient of INTEC. The long-term plume monitoring will monitor the concentrations of COCs as far downgradient of the INTEC facility as indicated by the detection of COCs above MCLs.

Because the RG is established in the year 2095, this study will continue through the institutional control period to at least 2095.

2.1.2.4 Develop a Decision Rule. This step of the DQO process brings together the outputs from Steps 1 through 4 into a single statement describing the basis for choosing among the listed alternatives. If the monitoring activities and model predictions generated for this study indicate that Group 5 RAOs/RGs will be exceeded due to the flux of contaminants in the SRPA beneath INTEC, then a comprehensive evaluation, focused feasibility study, and ROD amendment will be prepared to address the risks posed by groundwater contaminants beneath INTEC. If it is determined that the RAOs/RGs will be met, monitoring will continue until 2095 or until the Agencies determine that no unacceptable risk exists from Group 5.

The decision is based upon model predictions using data obtained from an observational well network to model evolution of the plume.

2.1.2.5 Specify Tolerable Limits on Decision Errors. This step of the DQO process specifies acceptable limits on decision error. These limits are used to establish performance goals for the data collection design. In this case, the decisions will be made by evaluating computer predictions, and thus, the accuracy of the computer predictions will bound the tolerable limits on the decision errors.

2.1.2.6 Optimize the Design. A flow chart presenting the conceptual design of the Group 5 field activities is provided in Section 2, Figure 2-1. The flow chart details the steps to be taken to both arrive at a contingent remedy decision and to perform the SRPA interim monitoring. The two separate flow paths are identified on the chart. The following paragraphs describe the rationale for the design of field activities related to the contingent remedy decision.

Thirty-six wells that are available in the vicinity of INTEC are suitable for groundwater monitoring. From that set of wells, 11 are selected for the INTEC facility monitoring program to support

PSQ-1, monitoring of the contaminant input from the vadose zone to the SRPA. The PSQ-1 INTEC facility monitoring will consist of groundwater-sample collection from wells located upgradient of, within, and adjacent to INTEC. The wells selected for monitoring include MW-18, USGS-40, USGS-42, USGS-47 through USGS-49, USGS-51, USGS-52, USGS-122, and USGS-123 (Figure 4-1 gives well locations). One well, USGS-121, was selected upgradient of the contaminant source areas at INTEC to provide background groundwater quality data. Though this well is not directly upgradient of the INTEC facility, it is located nearer to the groundwater flow paths from potential sources of upgradient contamination (TRA or Naval Reactors Facility) than other wells and is, in that respect, well suited for providing upgradient water quality data. Several wells were selected inside INTEC (MW-18, USGS-47, USGS-48, USGS-49, and USGS-52) to help distinguish between the possible sources of groundwater contaminants. Wells USGS-40, USGS-42, USGS-51, USGS-122, and USGS-123 were selected because they are located along the southern and western boundaries of INTEC. The general direction of groundwater flow beneath INTEC is interpreted to be to the south-southwest. The selected wells are considered adequate for the INTEC facility monitoring and no new wells are considered necessary at this time. However, additional wells are currently planned for various other monitoring programs at INTEC. As these wells become available, they will be considered for inclusion into the INTEC facility-monitoring program.

The three wells selected for monitoring in support of PSQ-2, former injection well monitoring, are USGS-41, USGS-48, and USGS-59, based upon an evaluation of their suitability for monitoring the aquifer below the HI interbed. There are 12 USGS wells in the vicinity of INTEC and the former injection well that penetrate the HI interbed and remain as open boreholes in the aquifer, potentially suitable for long-term monitoring of the aquifer beneath the HI interbed (excluding INTEC production wells that are required for facility support and cannot be modified to sample below the HI interbed). The wells are USGS-40 through USGS-49, USGS-51, USGS-52, and USGS-59. These wells are located either cross-gradient or downgradient of the former injection well. An evaluation of available data from, and additional geophysical and borehole fluid logging of, these wells will be performed to determine if the selected wells are suitable for deep sampling and to identify potential zones for sampling. (Note: because these wells are completed with an open borehole, there is a significant possibility that the deeper portions of one or more of these may be obstructed, requiring the selection of an alternate well from the 12 wells identified above.) It should be noted that an upgradient monitoring well that penetrates the HI interbed is not available within the existing monitoring well network at INTEC. Well USGS-121 does not penetrate the HI interbed. Production wells CPP-1, CPP-2, and CPP-4 have been drilled through the HI interbed and have perforated well casing both above and below the HI interbed but are of limited use as monitoring wells based upon their required support of INTEC operations. The need for an upgradient monitoring well in this zone will be evaluated after the monitoring program is initiated. If the data obtained from the facility monitoring program indicate that the injection well may cause or contribute to not meeting the Group 5 RAO/RGs, an upgradient well will be installed for sampling beneath the HI interbed to ensure that there is no upgradient contaminant source present. Also, current plans for OU 3-14 investigation include the installation of a monitoring well in the immediate vicinity of the former injection well. As the additional well(s) become available, they will be incorporated into the INTEC facility monitoring well program to provide additional data in the vicinity of the injection well.

In addition to the above monitoring, one sampling round will be conducted using the entire INTEC monitoring network at the onset of the activities outlined in this LTMP. This baseline sampling event will provide information on the current state of the contamination of the SRPA in the vicinity of INTEC and provide a data set to compare the COC flux monitoring data. These data will be used to update the OU 3-13 numerical aquifer model. In support of Group 4 activities, groundwater samples collected during the baseline sampling event from USGS-40, USGS-42, USGS-47–49, USGS-51–52, USGS-121–123 and MW-18 will be analyzed for stable isotopes, including oxygen, hydrogen, and nitrogen.

Micropurge samples will be collected from the 20 wells in the semiannual sampling in the first year. The standard samples and the micropurge data will be analyzed by statistical methods to determine if the data are comparable. If the data sets are comparable, the micropurge method will be used to collect future samples. Statistical equivalency will be determined by doing a student t-test on the data and by looking at historical data to see if the data falls within historical trends. To determine equivalency based on the T statistic, the null hypothesis, H_o, assumes that the true mean difference is zero and is tested by comparing the t statistic to the appropriate tabled t value. If $T < -t_{\alpha/2,n-1}$ or $T > t_{\alpha/2,n-1}$, where α is the level of significance and n is the degrees of freedom, then null hypothesis is rejected and it is concluded that the true mean difference is significantly different from zero. If $T > -t_{\alpha/2,n-1}$ and $T < t_{\alpha/2,n-1}$, then the null hypothesis is accepted and it is concluded that there is not enough evidence to suggest that the true mean difference is significantly different from zero. This hypothesis testing will be conducted to a confidence level, or α, of 0.05 or the probability of rejecting the null hypothesis when it is in fact true at 5%.

Six wells have been selected for long-term monitoring of the INTEC plume beyond the facility boundary in support of PSQ-3. The wells selected for long-term monitoring are USGS-57, USGS-67, USGS-112, USGS-113, USGS-85, and LF3-08. These wells were selected based on a review of the historical data for I-129. However, most of the data used to select these wells for long-term monitoring is from 1990–1991; therefore, the baseline groundwater sampling data will be used to optimize the well locations and the total number of wells for long-term monitoring.

Analytes of interest include COCs that currently exist in the SRPA at concentrations exceeding either MCLs or risk-based concentrations, as well as COCs derived from the modeling, which are predicted to potentially cause a future unacceptable risk to the SRPA. Contaminants that currently exceed MCLs or risk-based concentrations and will be included in the INTEC facility monitoring program are I-129, Sr-90, and tritium. Contaminants that are predicted by the WAG 3 RI/FS modeling to exceed MCLs or risk-based concentrations at a future date, and are included in the INTEC facility monitoring program, are plutonium and uranium isotopes, Np-237, Am-241, and mercury. Chromium, while listed as a COC, is excluded here because it is specifically related to groundwater contamination at TRA. Because Tc-99 is a contributor to the total beta-emitting radionuclide limit and is present at significant concentrations in the aquifer beneath INTEC, it is included in the list of analytes for INTEC facility monitoring. To evaluate additional radionuclides that may be present but not accounted for in the modeling, gross-alpha and gross-beta analyses will also be performed. Finally, the list of analytes will be updated through either the exclusion of some analytes or inclusion of additional analytes as analytical data are accumulated or new information regarding contaminant sources is identified. The detection limits for I-129, Sr-90, and tritium required to make the decisions needed concerning the contingent remedy are 0.1 pCi/L, 0.8 pCi/L, and 2,000 pCi/L, respectively.

Sampling and analyses will occur at the following frequency:

Year 1	Baseline and Semiannual	Tritium, Tc-99, I-129, Sr-90, plutonium isotopes, uranium isotopes (U-234, -235, and -238), Am-241, Np-237, Cs-137, gross-alpha/beta, and mercury; metals and anions in semiannual and micropurge sampling only
Years 2–7	Annual	Tritium, Tc-99, I-129, Sr-90, plutonium isotopes, uranium isotopes (U-234, -235, and -238), Am-241, Np-237, Cs-137, gross-alpha/beta, and mercury

Years 8–16	Biannual	Review and adjust as required
Years 17–100	Once every 5 years	Review and adjust as required.

Following each sampling event and prior to each CERCLA 5-year review, the new groundwater sampling results will be compared against the OU 3-13 aquifer model predictions to determine how concentrations compare to the model-predicted trends. If the new data indicate the necessity, the model will be updated, generating new COC concentration predictions. These predictions will be compared against the Group 5 RAO/RGs to determine if they will be exceeded. If the data trends exceed model-predicted trends and indicate a potential to exceed the Group 5 RAO/RGs, the sampling frequency will revert to annual sampling and progress in a manner similar to the schedule above.

2.1.2.7 State the Problem. The WAG 3 ROD requires monitoring activities to determine whether present contaminants in Group 5 or the flux of contaminants originating from within the INTEC security fence will affect the aquifer such that Idaho groundwater quality standards or risk-based concentrations will not be met in Group 5 in 2095.

2.1.3 Performance Standards (RAOs and RGs)

2.1.3.1 Remedial Action Objectives. The remedial action for Group 5, SRPA, will be evaluated against the RAOs and RGs established in the WAG 3, OU 3-13 ROD (Section 8) (DOE-ID 1999). The RAOs for OU 3-13 were developed in accordance with the S.O. NCP and CERCLA RI/FS guidance. The RAOs specify the contaminants and media of concern, potential exposure pathways, and RGs. The RGs establish acceptable exposure levels that protect human health and the environment. Factors that are considered in establishing RGs are outlined in 40 CFR 300.430(e)(2)(1). RAOs are specific risk criteria that take into consideration the assumed future land uses at INTEC. The RAOs are primarily based on the results of the baseline risk assessment and ARARs.

The INTEC land use assumptions used to develop the RAOs include industrial use prior to 2095 and potential residential use after that time. Other assumptions used to develop the RAOs, as listed in the ROD, include

- The INTEC facility will be used as an industrial facility up to the year 2095. During the period of DOE operations (expected to last to at least 2045), this area is a radiological control area. Only the contaminated groundwater present in the SRPA outside of the current INTEC security fence is addressed in the OU 3-13 ROD. The selected remedy is expected to fully address this contamination. However, this action does not address groundwater inside the INTEC security fence, which will be addressed under OU 3-14.

- For the time period 2095 and beyond, it is assumed that the SRPA located outside the current INTEC security fence will be used as a drinking water supply.

- The annual carcinogenic risk at the INTEC from natural background radiation due to surface elevation and background soil radiological contamination is 10^{-4} (EPA 1994b, NEA 1997, UNEP 1985).

- Permanent land use restrictions will be placed on those release site source areas and the ICDF Complex, which will be closed in place, for as long as land use and access restrictions are required to be protective of human health and the environment.

To achieve a reasonable degree of protection at the WAG 3 sites, the Agencies have selected a remedy for each group of sites that meet the RAOs. These remedies protect human health and the environment and meet regulatory requirements. The WAG 3 RAOs were developed for specific media (i.e., soils, perched water, or groundwater). The applicable RAOs for a particular site or group of sites depend on the specific media impacted. The RAOs, which are listed in Section 8 of the ROD (DOE-ID 1999), and are directly applicable to Group 5, include

NOTE: *RAO numbering below is same as in the ROD.*

1. Groundwater:

   a. For INTEC-impacted groundwater located in the groundwater contaminant plume outside the INTEC security fence, restore the aquifer for use by 2095 and beyond, so that the risk will not exceed a cumulative carcinogenic risk of 1×10^{-4} for groundwater ingestion

   b. For INTEC-impacted groundwater located in the groundwater contaminant plume outside the INTEC security fence, restore the aquifer to drinking water quality (below MCLs) for use in 2095 and beyond

   c. For INTEC-impacted groundwater located in the groundwater contaminant plume outside the INTEC security fence, restore the aquifer so that the noncarcinogenic risk will not exceed a total hazard index of 1 for groundwater ingestion.

2. SRPA (INTEC-derived groundwater contaminant plume outside the INTEC security fence):

   a. In 2095 and beyond, ensure that SRPA groundwater does not exceed a cumulative carcinogenic risk of 1×10^{-4}; a total hazard index of 1; or applicable State of Idaho groundwater quality standards (i.e., MCLs).

2.1.3.2 Remediation Goals. To meet the RAOs, RGs are established. These goals are quantitative cleanup levels based primarily on risk to human health and the environment. The RGs are based on the results of the baseline risk assessment and evaluation of expected exposures and risks for selected alternatives. If an ARAR is more restrictive, then the ARAR standard is used as the RG. The RGs will be used to assess the effectiveness of the selected remedial alternatives in meeting the RAOs. RAOs, discussed below, were developed in the ROD in Section 8 (DOE-ID 1999).

RGs for INTEC-derived COCs in the SRPA groundwater outside the INTEC security fence are based on the applicable State of Idaho groundwater quality standards (IDAPA 16.01.011.200). The SRPA COCs consist of H-3, Sr-90 and daughters, I-129, Np-237, chromium, and mercury until 2095, and Sr-90, I-129, Np-237, plutonium and uranium isotopes and their daughters, and mercury in 2095 and beyond. The SRPA groundwater RGs for these COCs are presented in Table 2-2.

The RG for INTEC-derived alpha-emitting radionuclides (i.e., Np-237, Pu isotopes and their daughters, Am-241, and U isotopes and their daughters) in the SRPA groundwater outside the current INTEC security fence corresponds to a cumulative alpha-activity of 15 pCi/L in the year 2095 and beyond. WAG 3 RI/FS modeling has shown that alpha-emitting radionuclides are not expected to exceed the 15 pCi/L standard in the SRPA inside the current INTEC security fence until the year 2750, with a peak concentration occurring in the year 3804. Remediation, if necessary, of the tank farm inside the current INTEC security fence is expected to mitigate the future alpha-emitting radionuclide impacts in the SRPA outside the current INTEC security fence. RGs for the alpha-emitting radionuclides in the SRPA inside the current INTEC security fence will be established in the final action developed in OU 3-14.

Table 2-2. SRPA contaminant of concern RGs.

Contaminant of Concern	SRPA RGs (Maximum Contaminant Levels) For Single COCs	Decay Type
Beta/gamma-emitting radionuclides	Total of beta/gamma-emitting radionuclides shall not exceed 4 mrem/yr effective dose equivalent	Beta/gamma
Sr-90 and daughters	8 pCi/L	Beta
Tritium	20,000 pCi/L	Beta
I-129	1 pCi/L as sole β–γ emitter, all included to demonstrate compliance against 4 mrem/yr	Beta/gamma
Alpha-emitting radionuclides	15 pCi/L total alpha-emitting radionuclides	Alpha
Uranium and daughters	15 pCi/L this includes all α emitters except as specified in 40 CFR 141.16	Alpha
Np-237 and daughters	15 pCi/L this includes all α emitters except as specified in 40 CFR 141.16	Alpha
Plutonium and daughters	15 pCi/L this includes all α emitters except as specified in 40 CFR 141.16	Alpha
Am-241 and daughters	15 pCi/L this includes all α emitters except as specified in 40 CFR 141.16	Alpha
Nonradionuclides		
Chromium	100 µg/L	Not applicable
Mercury	2 µg/L	Not applicable

The RG for beta/gamma-emitting radionuclides (H-3, Sr-90 and daughters, and I-129) in SRPA groundwater outside the current INTEC security fence is restricted to a cumulative dose of 4 mrem/yr in the year 2095 and beyond. The RGs for chromium and mercury are 100 µg/L and 2 µg/L, respectively, for individual constituent MCLs.

2.1.4 Performance Measurement Points

The Group 5 RA performance will be evaluated against the Group 5 RAOs and RGs discussed above. The performance measurement point for the Group 5 RA resides in the SRPA at the boundary of the INTEC security fence where COC concentrations must not exceed either a carcinogenic risk of 1×10^{-4}, an hazard index of 1, or drinking water standards (i.e., MCLs) in the year 2095 and beyond. All wells downgradient of the INTEC boundary must similarly meet drinking water standards by 2095.

However, because the RAO establishes that the performance criteria will be met in the year 2095 and beyond, present day measurement of whether or not RAOs are achieved is not possible. Numerical model predictions based on vadose zone moisture content and COC concentrations trends in both the vadose zone and the aquifer beneath the INTEC are required to determine if the RAO will be met in 2095 and beyond. The monitoring program for vadose moisture content and COC concentrations in both the vadose zone and SRPA is established (Note: perched water and vadose zone monitoring beneath INTEC will be accomplished under the Group 4 monitoring program) to support the numerical modeling. Data obtained from the soil moisture monitoring and COC concentration sampling, as well as additional data regarding stratigraphy, lithology, and other new information, will be incorporated into the WAG 3 model to periodically update the model predictions for COC concentrations in 2095. Until the year 2095, this modeling will be utilized to predict whether the RAOs are being met.

2.1.5 Rationale for Selection of Performance Measurement Points

Performance measurement points for Group 5 are based directly on the RAOs that are presented in the OU 3-13 ROD (DOE-ID 1999). The RAOs take into consideration land use assumptions and protect human health and the environment. The primary cause for establishing the performance measurement point at the security-fence boundary of INTEC in 2095 is the land use assumption stating that the SRPA outside the INTEC security fence will be available for residential use in 2095. For this reason, water quality outside of the INTEC security fence in 2095 and beyond must meet drinking water standards.

2.1.6 Group 5 Snake River Plain Aquifer ARARs

A complete listing of the applicable Group 5 ARARs, including an explanation of how they will be met on this project, is included in Section 3.2, Detailed Evaluation of How ARARs Will Be Met.

2.1.7 Technical Factors of Importance in Design and Construction

Drilling Through Perched Water **—**The construction of monitoring wells south of INTEC may involve drilling through zones of perched water. Well construction design for these wells must account for the potential difficulties in encountering saturated zones above the water table, primarily in the form of flowing sediments or large volumes of water draining down the well as drilling proceeds through and below the saturated zones. For this reason, it will be necessary to seal these saturated zones from the borehole. This will generally be performed through grouting and casing the unstable zone, reducing the drill bit size, and continuing drilling to the target depth.

3. DESIGN BASIS

3.1 Status of Record of Decision Assumptions

The bounding assumptions under which the Group 5 RD/RA activities will be performed include the assumptions presented below. These assumptions describe the limiting factors and conditions under which the RD/RA activities will be performed. The general assumptions relative to OU 3-13 Group 5 include the following:

- Monitoring for each group will be performed as part of RD/RA and is separate from institutional controls.
- A minimum institutional control period to the year 2095 for land use or access restrictions required to be protective will be implemented at all sites where contaminant concentrations exceeding allowable risk ranges are left in place. The continued need for land use or access restrictions will be evaluated by the Agencies during each 5-year review.
- Institutional controls until 2095 will consist of site access controls, radiological posting controls, and land use controls as shown in Table 11-1 of the ROD (DOE-ID 1999).
- The overall RAO for OU 3-13 is to achieve an hazard index of 1.0 or less and a cumulative increased carcinogenic risk of less than 1×10^{-4}.

In addition to the general assumptions applicable to all groups, the specific assumptions for Group 5, SRPA, include the following:

- Institutional controls over the area of the aquifer exceeding the MCLs for H-3, I-129, and Sr-90 will be protective by restricting future groundwater use through use of deed restrictions and regulatory restrictions on drilling, construction, and placement of groundwater wells. Notice of these restrictions will be given to local county governments, such as Sho-Ban Tribal Council, GSA, and BLM.
- COCs will meet the groundwater quality standards by the year 2095, based on computer-modeled predictions.
- If the action level of 11.4 pCi/L for I-129 is exceeded in selected monitoring wells at a sustainable pump rate of 0.5 gpm for a period of 24 hours (south of the INTEC security fence), then the contingent remediation pump and treat will be implemented.
- Monitoring of the SRPA for Idaho water quality parameters and federal MCLs will be used to evaluate effectiveness of the remedies with specified RGs of protecting the SRPA.
- Implementation of the contingent remedy depends upon the results of the groundwater monitoring.
- If groundwater treatment is implemented, the treated water will be returned to the aquifer by land recharge in accordance with Idaho Wastewater Land Application ARARs if a recharge impoundment is used, by discharge to the Big Lost River in accordance with NPDES/State Pollutant Discharge Elimination System (SPDES) ARARs, or by evaporation in the ICDF Complex evaporation pond or equivalent.
- Long-term monitoring will be required until RAOs are achieved.

3.2 Detailed Evaluation of How ARARs Will Be Met

Table 3-1 contains a list of the ARARs identified in the ROD for Group 5, along with the specific action(s) that will be taken to ensure the ARARs are met.

3.3 Detailed Justification of Design Assumptions

Modeling of the SRPA for the WAG-3 OU 3-13 RI/BRA (DOE-ID 1997a) predicted a future risk to groundwater users due to high concentrations of I-129 and Sr-90 predicted in the low-hydraulic conductivity HI sedimentary interbed beyond the year 2095. However, only a limited amount of empirical data are available to confirm the physical properties of the HI interbed as assumed in the OU 3-13 RI/BRA model and there is no data regarding the presence or absence of contaminants in the interbed. Empirical evidence of the HI interbed contamination and permeability is required to verify the model predictions and refine the model parameterization in the event that observed concentrations exceed the action levels defined in the WAG-3 ROD.

Sensitivity of the model parameterization was performed to identify key data needs and support field activities to collect empirical data. A refined and recalibrated model will then be used to determine if contamination within the HI interbed still presents a risk to groundwater users in the event that observed concentrations exceed action levels. Iodine-129 was chosen as the indicator contaminant for model sensitivity because it is long-lived and was predicted to present the greatest contaminant risk within the interbed. The tasks performed to assess model sensitivity are (1) review of the OU 3-13 RI/BRA model, (2) review of the I-129 source term in the model, (3) sensitivity analysis of HI interbed hydraulic conductivity, and (4) sensitivity analysis of HI interbed thickness and discretization. A more detailed discussion of the RI/BRA modeling and sensitivity of model parameterization is included in Appendix C.

3.3.1 Review of the WAG-3 OU 3-13 RI/BRA Aquifer Model

The physical and hydrogeologic setting of the INTEC is highly complex, consisting of layers of basalt and sediments. In the vadose zone, the sedimentary interbeds are often saturated, forming perched water zones due to large water sources at the INTEC surface. The geology of the aquifer region is more uniform in the vertical direction than the geology of the vadose zone. The basalt structures tended to be thicker, and the sedimentary interbeds were fewer in number. USGS studies (Anderson and Lewis 1991) indicate that the aquifer in the region north of the INTEC and extending south of the RWMC is comprised primarily of the H basalt flow, the HI interbed, and the lower I basalt flow. The I basalt flow is significantly thicker and has a lower permeability than the H basalt flow (Anderson and Lewis 1991). The HI interbed separates the two basalt flows. Two separate models were used to represent the vadose zone and the aquifer beneath the INTEC. The basis and simulation results for the aquifer model are briefly discussed here.

The aquifer model used four distinct stratigraphic types. These include an upper I basalt unit, a lower I basalt unit, the HI interbed, and the H basalt unit. The upper I basalt structure was assigned permeabilities representative of those obtained from aquifer testing the INTEC pumping and injection wells. The lower I basalt and H basalt structure was assigned regional permeabilities taken from the WAG-10 modeling effort (McCarthy et. al. 1994). The H basalt structure in the vicinity of the vadose zone footprint was assigned local INTEC permeabilities from the pumping tests.

Table 3-1. Compliance with ARARs for Group 5, Snake River Plain Aquifer interim action selected remedy.

Alternative/ARARs citation	Description	Applicable, or Relevant and Appropriate, or TBC[a]	Comments
Group 5—Snake River Plain Aquifer: Alternative 2B—Institutional Controls with Monitoring and Contingent Remediation			
Action-Specific			
IDAPA 37.03.09.025	Idaho well construction standards	Applicable	Applies to SRPA monitoring.
IDAPA 58.01.05.008 (40 CFR 264.114)	Disposal or decontamination of equipment, structures, and soils	Applicable	Applies to drilling, sampling, and treatment equipment that contacts SRPA groundwater.
IDAPA 58.01.01.585, 58.01.01.586	Rules for the control of air pollution in Idaho	Applicable	Will be met by treatment system.
IDAPA 58.01.01.650, 58.01.01.651	Idaho fugitive dust emissions	Applicable	Will be met for contaminated drill cuttings.
40 CFR 61.92, 61.93	NESHAP for radionuclides from DOE facilities, emission monitoring and emission compliance	Applicable	Will be met using engineering and administrative controls.
40 CFR 125	NPDES		Applies if contingent remediation is implemented and treated groundwater is discharged to the Big Lost River.
10 CFR 20, Appendix B	Annual limits for effluent concentrations	Applicable	Applies if treated water is discharged.
40 CFR 122.26	Storm water discharges during construction	Applicable	Substantive requirements will be met.
IDAPA 58.01.05.008 (40 CFR 264.601)	Treatment standards for miscellaneous units	Applicable	Specific requirements will be clarified and met in 10% design.
IDAPA 58.01.17.300	Wastewater land application permit requirements	Applicable	Applies if treated wastewater is discharged to a percolation pond; substantive requirements will be met.
IDAPA 58.01.02.400	Rules governing point source discharge	Applicable	Applies if treated wastewater is discharged to the Big Lost River.
IDAPA 58.01.02.401	Point source wastewater treatment requirements	Applicable	Applies if treated wastewater is discharged to the Big Lost River.
Chemical-specific			
IDAPA 58.01.05.006 (40 CFR 262.11)	Hazardous waste determination	Applicable	Applicable to groundwater that will be stored long-term or treated.

Table 3–1. (continued).

Alternative/ARARs citation	Description	Applicable, or Relevant and Appropriate, or TBC[a]	Comments
IDAPA 58.01.11.200(a) (40 CFR 141) for:	Groundwater quality standards (primary drinking water standards)	Applicable	This ARAR will be met in the restoration timeframe (2095) in the SRPA contaminant plume outside of the current INTEC security fence. Any recharge to the SRPA will be limited to concentrations so that this ARAR will be met in 2095.
Gross alpha particle activity (including radium-226, but excluding radon and uranium)			
Combined beta/photon emitters			
Combined radium-226 and radium-228			
Strontium-90			
Tritium			
Location-specific			
None identified			
TBCs			
DOE Order 435.1	Radioactive waste management performance objectives to protect workers	TBC	Substantive requirements will be met to protect workers.
DOE Order 5400.5	Exposures to the public will be kept ALARA	TBC	Substantive ALARA requirements will be met to protect the public.

a. TBC = to be considered

To be consistent with the sediment properties used in the vadose zone model, a permeability of 4 mDarcy and a porosity of 0.487 were assigned to the HI interbed, which overlies the I basalt flow. Assigning sediment properties uniformly over the I flow assumed that the HI interbed is 7.6 m (25 ft) thick and exists everywhere the I basalt flow exists. The porosity for the aquifer model basalt was 0.06. This value was derived from calibration of the model to H-3 disposal records and the corresponding H-3 sampling results from wells in the vicinity of INTEC.

Aquifer Model Calibration for OU 3-13 RI/BRA

The OU 3-13 RI/BRA aquifer flow model relied on the WAG-10 model calibration (McCarthy et. al. 1994) and the hydraulic parameters were not adjusted in the transport calibration process. Calibration of the transport model used the H-3 disposal history in the CPP-03 injection well. The H-3 disposed in CPP-03 provided good calibration data because H-3 is nonsorbing, and because mass disposal history from 1953-1984 along with time histories at wells downgradient are available.

Review of I-129 Source Term

The historical I-129 source term at the INTEC is described in Chapters 5 and 6 of Appendix F of the WAG-3 OU 3-13 RI/BRA report (DOE-ID 1997a). For the RI/BRA study, the INTEC releases were defined as one of three types: (1) known releases, (2) service waste releases, or (3) soil contamination releases. The following contaminant sources were evaluated in the OU 3-13 study:

- The I-129 source from the tank farm releases, based on estimates of the liquid release volumes and the I-129 concentrations in the liquid released. The I-129 contribution from the tank farm is 0.007 Ci, which is 0.5% of the total.

- The I-129 source from the injection well is 1.39 Ci, which is significantly larger than the other sources, accounting for 91.5% of the total I-129 source to the aquifer. The injection well source term was estimated from data in the Radioactive Waste Management Information System database.

- The I-129 source from the Service Waste Ponds (SWP) is 0.08 Ci, which is approximately 5.4% of the total I-129 source to the aquifer.

- The I-129 source from the soil contamination was calculated to be 0.04 Ci, which is approximately 2.5% of the total I-129 source to the aquifer.

Review of OU 3-13 RI/BRA I-129 Simulation Results

The OU 3-13 RI/BRA modeling predicted that a relatively large area of the SRPA will have I-129 concentrations greater than the 1 pCi/L MCL at the year 2095. Two areas of the HI interbed contained I-129 at concentrations above the MCL. The first area is immediately southwest of the INTEC and has a peak concentration of 3.0 pCi/L. The second area is west of Lincoln Boulevard and north of State Highway 20 and has a peak concentration of 1.4 pCi/L. These values are different from those presented in Appendix F of the OU 3-13 RI/BRA because of a coding error in TETRAD version 12.2. The RI/BRA I-129 simulation was rerun with TETRAD version 12.7.

3.3.2 Aquifer Model Sensitivity

Model Discretization Sensitivity

The OU 3-13 aquifer model has been rediscretized to estimate the model sensitivity to a single-layer HI interbed vs. a multiple-layer interbed with bottom surface below the HI interbed. The RI/BRA model treats the vertical component of the HI interbed as a single numerical grid block of constant (7.6 m [25 ft]) thickness. This one grid block discretization averages concentrations throughout the entire depth of the interbed and does not allow a vertical concentration gradient to exist in the interbed. This effect may allow an artificially large amount of mass to enter and remain in the interbed.

The OU 3-13 aquifer model also used a uniform 76-m total thickness, which did not extend below the HI interbed. Placement of the OU 3-13 model's bottom surface above the HI interbed's lowest point presents potential for erroneous low or high velocity areas due to extreme confining conditions. The rediscretized model's bottom surface was created from active aquifer thickness estimates, which were below the HI interbed.

The rediscretized model predicts the peak aquifer I-129 concentration will be 0.62 pCi/L in the year 2095. This is in contrast to the OU 3-13 RI/BRA model, which predicted the peak concentration would be 3.0 pCi/L in the year 2095 and a large area of the HI interbed south of the INTEC would remain above the 1.0 pCi/L beyond 2095. This is primarily due to the rediscretization of the HI interbed and placing the model bottom below the HI interbed. Iodine-129 still persists in the rediscretized model's HI interbed, but to a lesser extent of that in the RI/BRA model. In both models, the I-129 takes a relatively long time to enter and exit the interbed compared to basalt. This is because of the low permeability (4 mD compared to approximately 1×10^5 mD) and high porosity (0.487 vs. 0.0625) of the interbed compared to basalt. In the RI/BRA, model I-129 persists longer within and above the HI interbed because of low velocity areas created by the different HI interbed placement. It is important to note that the rediscretized model has not been calibrated to tritium disposal and breakthrough, as the RI/BRA model was. The I-129 plumes in both models are comparable. However, the axis of the rediscretized model's plume has shifted slightly westward.

Model HI Interbed Permeability Sensitivity

The low permeability of the HI interbed is primarily responsible for maintaining elevated I-129 concentrations in the simulated SRPA. There is very little data available on the permeability of the HI interbed. The OU 3-13 RI/BRA aquifer modeling used an interbed permeability (4 mD) from the vadose zone model calibration to perched water bodies beneath the INTEC. There is little confidence that vadose zone calibration adequately represents the HI interbed permeability within the aquifer. HI interbed pumping tests performed by the State of Idaho (Fredrick and Johnson 1996) provide the only hydraulic conductivity information available specifically for the HI interbed. Analysis of the pumping test data suggests the permeability range is 37 mD to 100 mD. Therefore, the 4 mD used for the WAG 3-13 modeling is at least an order of magnitude low. Information on the INTEC vadose zone interbed permeability ranges from 0.05 mD to 3,500 mD. An average permeability of 40 mD is on the low end of the most appropriate permeability value. The 4 mD used in the RI/BRA modeling represents a low bounding value and 200 mD represents a high bounding value.

HI interbed permeability in the RI/BRA and rediscretized models was varied from 4 to 200 mD and peak concentrations and the size of the I-129 plume in 2095 were compared. The area of the remaining plume in 2095 is very sensitive to permeability and monotonically decreases in size with increasing permeability for both models. The RI/BRA model area of the 0.1 pCi/L plume decreased from 70.6 to 45.4 km^2 for the 4 and 200mD interbed permeability, respectively. The rediscretized model 0.1 pCi/L area decreased from 26.4 to 10.2 km^2 for the 4 and 200 mD simulations. The peak concentrations in the year 2095 did not monotonically decrease with increasing permeability. The RI/BRA model's peak values ranged from 2.1 pCi/L for the 8 mD permeability to 3.4 pCi/L for the 40 mD permeability simulation. The rediscretized model's peak values ranged from 0.25 pCi/L for the 40 mD simulation to 4.1 pCi/L (limited to one gridblock aerial extent) for the 8 mD simulation. The varied peak concentrations in 2095 for the different interbed permeabilities indicate flow field substantially changes with different interbed permeabilities, which results in different areas retaining high I-129 concentrations.

3.3.3 Modeling Data Needs

Contaminant concentration data in the aquifer basalt and HI interbed are needed to verify whether modeling is correctly simulating the interaction of basalt and interbed, and accurately represents the SRPA. At this time, elevated I-129 and other contaminant concentrations in the interbed are hypothetical, based on modeling. Answering this data need can best be accomplished by gathering a vertical profile of aquifer concentrations above, within, and below the HI interbed at several locations. The area immediately south of the INTEC percolation ponds and the area near the Central Facilities Area are of particular interest because these areas are predicted to have elevated HI interbed I-129 concentrations now and retain concentrations near the 1 pCi/L MCL in the year 2095.

The aerial extent of contamination in the year 2095 was very sensitive to permeability in both the rediscretized and RI/BRA models. This indicates that interbed permeability on a field scale at several locations is needed to verify the RI/BRA model's homogeneous 4 mD HI interbed permeability. HI interbed permeability investigations should not be limited to evaluation of retrieved cores because hydrological properties of INEEL core rarely represent INEEL conditions on a field scale. The most useful HI interbed permeability measurements would be obtained from a straddle packer type pumping test of the in situ HI interbed.

Additional interbed elevation and thickness data are also needed. However, it may not be practical or feasible to gather enough data to adequately describe the HI interbed elevation and thickness with statistical confidence because of the variability of the data and the large area of interest.

3.3.4 Modeling Path Forward

The discretization and the HI interbed permeability sensitivity analyses suggest the RI/BRA model was conservative in predicting persistent high I-129 concentrations in the HI interbed. Review of HI interbed permeability data indicates the simulated value should be 40 mD, and the permeability sensitivity analysis indicate areal extent of contamination in the year 2095 decreases with increasing permeability. However, before predictive simulations can be performed using the rediscretized model, the model must be calibrated to aquifer head and aquifer transport data. Both the OU 3-13 RI/BRA and the rediscretized flow models relied on the WAG-10 (McCarthy et. al. 1994) flow model calibration. A multitude of new wells have been drilled since the WAG-10 modeling, and the recent work by Smith (2000)[a] has provided an improved understanding of groundwater flow direction and active aquifer thickness in the vicinity of the INEEL. A comprehensive well head data set and the flow path work by Smith (2000)[a] should be incorporated into a flow model calibration effort. The CPP-03 injection well tritium disposal data still provide a good calibration data set and should be used along with the data gathered from the OU 3-13 Group 5 field investigation to recalibrate the updated flow and transport model.

a. Dr. Richard P. Smith, BBWI Geosciences Research (Department 4122), Technical presentation, INEEL, June 8, 2000.

The recalibrated flow and transport model should then be used to reassess I-129 risk before any remediation work begins or remediation strategies are developed.

3.4 Plans for Minimizing Environmental and Public Impacts

One of the general purposes of the FFA/CO is to “expedite the cleanup process to the maximum extent practicable consistent with protection of human health and the environment” (DOE-ID 1991). The parties to the FFA/CO intended that any response action selected, implemented, and completed under the agreement will be protective of human health and the environment such that remediation of releases covered by the agreement shall obviate the need for further response action.

Every effort has been made in the planning of this project to utilize well-established and available processes and guidance, and achieve compliance with CERCLA and Resource Conservation and Recovery Act (RCRA) processes. Special consideration has been given to the disposition of dangerous or emergency conditions.

If a dangerous/emergency condition is discovered that may pose “imminent and substantial endangerment to people or the environment,” DOE-ID, EPA, or IDHW have the authority to stop work per FFA/CO, Section 29.